

# **NCspeed optimising the Die Surface milling process for a large Stamping Die**

## **Evaluation test in Dagenham Tool&Die Ford Motor Company**

### **1. Summary**

The software NCspeed from FORMTEC GmbH is an optimisation system for NC-programs in the field of die and mould making process. NCspeed acts as a post-processor on standard MCD output and adapts the programmed feed rate to the actual cutter engagement conditions. The software reduces the feed rate in areas, where the milling tool has to cut high volumes of material whilst in uncritical areas with less or none material the feed rate is increased significantly. This results in total machining time savings of about 20% and more depending on the cutting strategy while achieving a better process stability at the same time with no manual intervention from the machine operator.



In this evaluation pilot at Ford's Tool&Die shop in Dagenham more than 40% machine time savings have been realised for the pre-finishing milling operations. The predicted improvement of the milling process stability could be proved in reality which may allow the operator to securely run more than one milling machine, a contribution towards man-less machine operation.

### **2. Test environment**

The MCD output of Jaguar's X400 lift gate inner punch die unit was optimised with the NCspeed software. The previous NC programming was done with a CAM-System using all today's commonly used strategies as roughing-in-plane, copymill and restmaterial in 3 and 3+2 axis mode with toroid and ball end cutters. The surface geometry of the part is symmetric and therefore one half of the workpiece could be milled with NCspeed and the other conventionally, letting the machine operator control the mill's feed. This enabled us to compare the actual milling time.

### **3. Test results**

#### **3.1. Roughing**

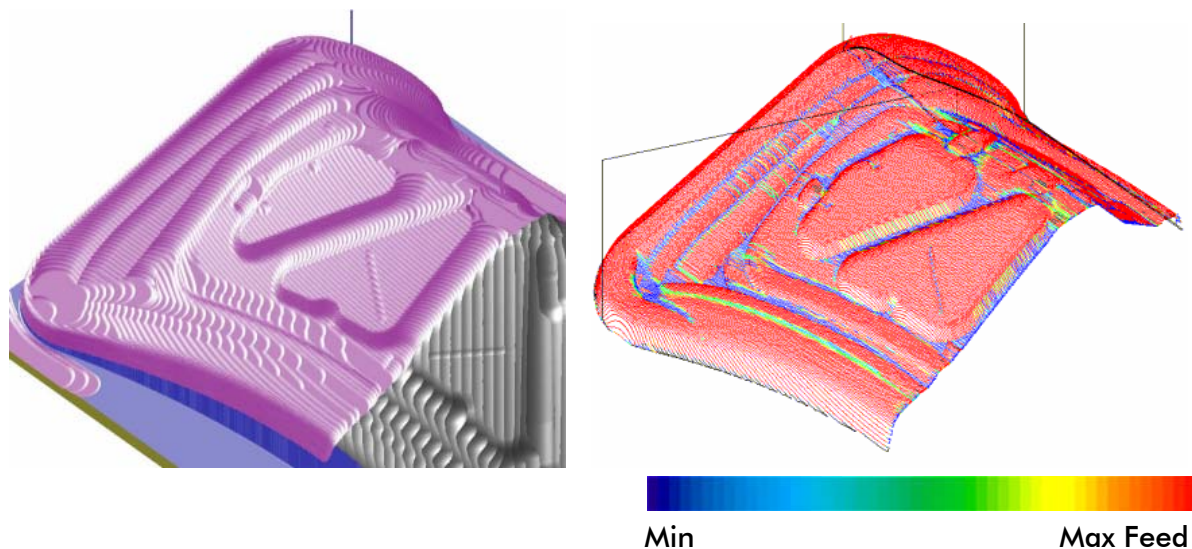
The selected CAM-strategy for roughing was roughing-in-plane. This commonly used method with its toroid cutters usually uses the conventional climbing option which generally results in a higher degree of air cuts and approaching/retracting movements

with a total increase of machining time. As NCspeed simulates the actual material stock condition, air cuts are speeded up and reduced (67 vs. 147 meter) and the cutting force on the cutter is kept constant by controlling the feed rate accordingly. In total, the milling time of this NC operation is decreased, results are shown in the next table.

course	feedrates			machining time		savings	
	original	optimised min	max	original	optimised	time	%
roughing	1000	750	1500	07:06:36	03:36:09	03:30:27	49

### 3.2. Semi-finishing

The first roughing process with its large cutter usually leaves much material in areas where the cutter can not plunge in. The NC programmer must take notice of this situation and plan the following milling strategies accordingly. As NCspeed simulates and displays the actual material situation it is also a valuable tool for the NC programmer to plan and set up the next NC operations as can be seen in the left picture.

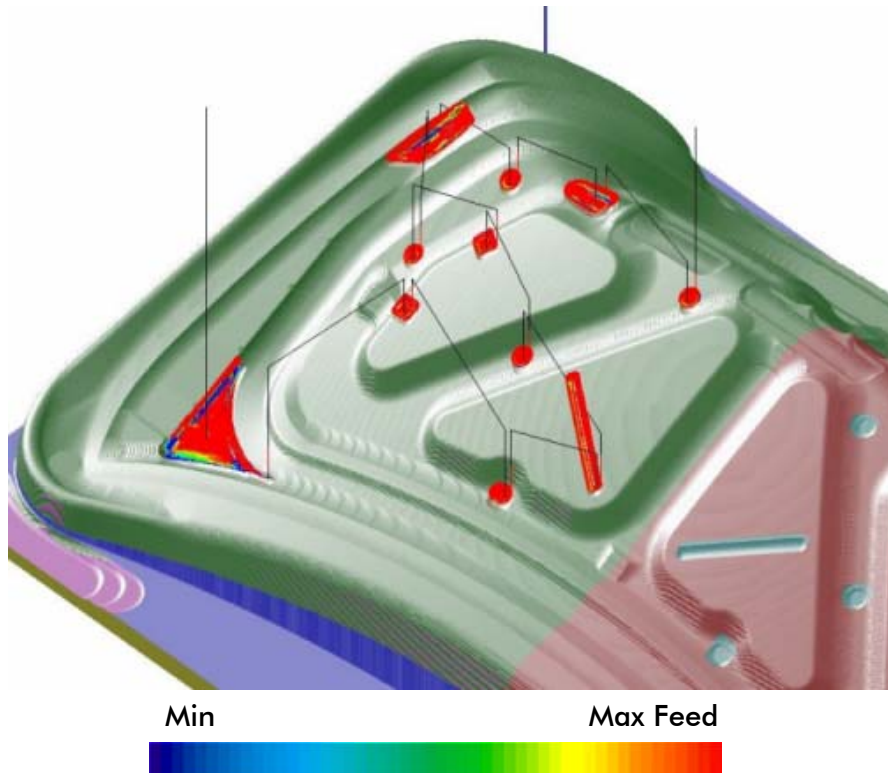


Based on the calculated material stock NCspeed simulates the cutting process and adjusts the machine feed to keep the cutter's stress as constant as possible. Blue coloured areas in the right picture indicate critical engagement conditions of the cutter with low feed rates detected and automatically adjusted by NCspeed. Specially all grooves and corners in the left picture are critical spots. Compared to the machine operator who diminishes the feed rate at the controller's level manually the simulation with NCspeed guaranties a saver process and an efficiency improvement of 59%.

course	feedrates			machining time		savings	
	original	optimised min	max	original	optimised	time	%
zick-zack	942	942	2500	06:05:00	02:30:00	03:35:00	59

### 3.3. Restmaterial Clean-up.

To get a uniform material offset on the die surface and to be prepared for the final High-Speed Cutting the rest material along grooves and convex corners must be cleaned. The CAM-System calculates the affected regions and delivers the cutter paths. NCspeed simulates the cutter's stress situation and adjusts the feed rates.



The savings in machine time are again tremendous. With the NCspeed optimised NC program the machine operator had not to approach the workpiece slowly and carefully and the NC programmer also encouraged him to push the start button and let the program run because he already checked and verified the milling process during the computer simulation.

course	feedrates			machining time		savings	
	original	optimised min max		original	optimised	time	%
corner picking	1000	500 2500		10:10:37	05:45:00	04:25:37	43

### 3.4. High Speed Finishing

The NC programmers experience in defining appropriate milling strategies and the ability of today's CAM systems yield to a very proportional material offset of usually 0.2mm across the workpiece's surface. Therefore generally speaking there is nothing or very little that can be optimised with NCspeed in this final High Speed Cutting operation.

### 3.5. Machining Time Totals:

course	feedrates			machining time		savings	
	original	optimised		original	optimised	time	%
		min	max				
profiling				0:10:44	0:10:44	00:00:00	0
roughing	1000	750	1500	7:06:36	3:36:09	03:30:27	49
zick-zack	942	942	2500	6:05:00	2:30:00	03:35:00	59
zick-zack front				1:08:00	1:08:00	00:00:00	0
zick-zack back				0:49:00	0:49:00	00:00:00	0
corner picking	1000	500	2500	10:10:37	5:45:00	04:25:37	43
zick-zack precut				0:15:00	0:15:00	00:00:00	0
finish top				3:55:12	3:55:12	00:00:00	0
finish bottom				8:27:36	8:27:36	00:00:00	0
finish left				1:27:34	1:27:34	00:00:00	0
			<b>sum</b>	<b>39:35:19</b>	<b>28:04:15</b>	<b>11:31:04</b>	<b>29</b>

### 3.6. Contacts

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